

REMARKS

This is a Divisional Application of U.S. Serial Number 09/447,432. Claims 1-31 are pending and await action on the merits. The specification has been amended to remove typographical errors. Support for claim 25 can be found in claim 1 and page 1, lines 24-26. Support for claim 26 can be found on page 16, lines 22-25. Support for claim 27 can be found in claims 1 and 12 and on page 10, line 3. Support for claim 28 can be found on page 9, lines 17-20. Support for claim 29 can be found on page 5, line 20. The range of specific surface area described in new claim 30 is a combination of the range of not less than 1 m²/g (claim 1) and the range of 1.5-100 m²/g as described on page 5, lines 24-25 of the specification. Support for new claim 31 can be found in claim 1. No new matter has been added by way of the above-amendment.

**Patentable Distinctions Over Taylor et al (either US 5,019,220 or
US 5,223,184)**

Since Taylor et al '220 is a Divisional Patent of Taylor et al '184, both are herein treated concurrently.

Part I -

These comments relate to the inventive composition wherein the third component is (3) a molybdenum compound of at least one selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid and ammonium molybdate.

Applicants submit that Taylor et al neither teach nor fairly suggest the instantly claimed composition wherein the third component is (3) a molybdenum compound of at least one selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid and ammonium molybdate. Taylor et al. support a lengthy generic disclosure for the preparation of gas generant compositions with a *single* example. In the single example, sulfur is added to a sodium hydroxide/soft water solution followed by the addition of molybdenum disulfide and sodium azide.

In a later step, the water is removed by evaporation followed by the pelletization of the solid composition. Upon inspection of the instant base claims 1 and 25, it is clear that none of the components of the instant claims are used in the *single* example given by Taylor et al.; therefore, claims 1 and 25 are not anticipated by Taylor et al.

Furthermore, Taylor et al. do not fairly suggest a nitrogen-containing organic compound and a molybdenum compound of at least one selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid and ammonium molybdate. In view of the large number components of the gas generant composition taught by Taylor et al. in columns 6 and 7, Applicants submit that it would not obvious to the skilled artisan to choose molybdenum oxide from lines 35 and 36 of column 6 and either an amide or tetrazole from lines 6 and 7 of column 7. In addition, the skilled artisan would view the working example of Taylor et

al. as a teaching away from the generic disclosure wherein amides or tetrazoles, or molybdenum oxides are possible choices. Obviousness does not exist if the prior art neither indicates which of the disclosed parameters are critical, nor gives direction as to which of many choices is likely to be successful. *Merck & Company, Inc. v. Biocraft Labs, Inc.*, (CAFC 1989) 874 F2d 804.

Regarding base claim 25, this claim is essentially the same scope as claim 1 except for the fact that there is a clause at the end of claim 25 which excludes alkali metal salts or alkaline earth metal salts of hydrazoic acid. Metal azides are a requirement of the gas generant composition of Taylor et al., and are excluded from claim 25, since the azide is toxic and the byproducts of the alkali components are also toxic. Thus, Applicants respectfully submit that new claim 25 is further distinguished from Taylor et al.

Part II -

The following comments relate to the inventive composition wherein the third component is at least one of items:

- (1) manganese dioxide having a specific surface area not less than 50 m²/g;
- (2) copper oxide having a specific surface area not less than 1 m²/g; and
- (4) a mixture of manganese dioxide and at least one metal oxide selected from the group consisting of copper oxides, cobalt oxides, iron oxides and silver oxides.

Regarding the cobalt oxides and silver oxides of component

(4), Taylor et al. do not teach or suggest compositions containing cobalt oxides or silver oxides.

Regarding the manganese, copper and iron oxides, Taylor et al. teach away from using these compounds. In the third paragraph of column 3, Taylor et al. teach,

"The overlying primary objective of the present invention is to minimize hazardous (potentially explosive) conditions created by the undesirable formation and build-up of hydrazoic acid and unstable azide compounds produced from such problematic impurity or contaminant metal ion species as... Fe, Mn and Cu..."

Furthermore, in lines 30-40 of column 5, Taylor et al. state,

"The molybdenum disulfide... has particularly high levels of such metals as... iron, copper, and manganese relative to the other formulation ingredients. Any resultant metal azides produced from these impurities or contaminant metal ions are very hazardous compounds in that they are explosive in nature and generally thermally sensitive. They may explode when subjected to friction, impact, ESD (electrostatic discharge), and when exposed to high thermal gradients."

Given the above teachings, the skilled artisan would not be motivated to choose either an iron oxide, manganese oxide or copper oxide from the generically disclosed possible components of the gas generant composition as described in lines 35 to 36 of column 6, since the skilled artisan would be cognizant of the fact that there would be ionic impurities found within these metal oxides which would readily form metal azides which are taught by Taylor et al. to be hazardous.

Additionally, Taylor et al. teach away from using a metal

oxide in lines 37-44 of column 6, wherein Taylor et al. teach:

"However, the preferred oxidizer/reactant is sulfur combined with a metallic sulfide... Least preferred is any water-soluble material having any of the problematic... Fe, Mn or Cu cations."

Applicants submit that a reference which leads one of ordinary skill in the art away from the claimed invention cannot render it unpatentably obvious. *Dow Chem. Co. v. American Cyanamid Co.*, 816 F2d 617 (CAFC 1987).

Part III -

The following comments relate to the unexpectedly superior properties of the inventive composition wherein the third component is at least one of items:

- (1) manganese dioxide having a specific surface area not less than 50 m²/g;
- (2) copper oxide having a specific surface area not less than 1 m²/g;
- (3) a molybdenum compound of at least one selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid, and ammonium molybdate; and
- (4) a mixture of manganese dioxide and at least one metal oxide selected from the group consisting of copper oxides, cobalt oxides, iron oxides and silver oxides.

Third Component (1) -

As can be seen from the following table, the inventive composition containing manganese dioxide having a specific surface area of not less than 50 m²/g has superior properties to

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compositions that do not contain manganese dioxide within this range.

TABLE 1

Example	MnO ₂	Specific Surface Area (m ² /g)	Parts By Weight	Carbon Monoxide Generated (%)	NO _x (ppm)
1-1 (Inventive)	present	260	8	0.8	1000
1-2 (Inventive)	present	104	8	1.1	1300
1-3 (Inventive)	present	260	10	0.6	700
1-1-1 (Comparative)	absent	Not Applicable	0	2.3	2000
1-1-2 (Comparative)	present	21.5	8	2.5	2000

As can be seen from the above-data taken from the present specification, the inventive composition containing manganese dioxide having a specific surface area of not less than 50 m²/g has superior properties to compositions that do not contain manganese dioxide within this range.

In general, a superior composition will generate a lower amount of carbon monoxide and nitrogen oxides. These results show that the carbon monoxide and nitrogen oxides generated from the composition is far less when using manganese dioxide within the inventive specific surface area range of not less than 50 m²/g.

Since Taylor et al fail to teach or suggest the superior properties obtained when using manganese dioxide having a specific surface area range of not less than 50 m²/g, Taylor et al do not make obvious this aspect of the present claims.

Third Component (2) -

Since Taylor et al are silent with respect to the surface area of the copper oxide, the skilled artisan would reasonably conclude that the surface area of the copper oxide does not effect the properties of the copper oxide which are relevant to the gas generating ability of the composition.

Applicants have unexpectedly found that the surface area of the copper oxide does effect the properties of the copper oxide which are relevant to the ability of the composition to generate a safer gas mixture upon ignition. In fact, the inventive gas generant composition containing copper oxide having a specific surface area of not less than $1 \text{ m}^2/\text{g}$ has an unexpectedly superior ability to generate a safer gas mixture upon ignition then gas generant compositions containing copper oxide having a specific surface area of less than $1 \text{ m}^2/\text{g}$.

The gas generant composition of Inventive Example 2-5 has an unexpected decrease in the amount of CO produced when compared to the gas generant composition of Comparative Example 2-2-4. These compositions differ only with respect to the specific surface area of the copper oxide. The compositions were tested for the amount of carbon monoxide produced in the gas generating reaction. A superior composition will generate a lower amount of carbon monoxide. Inventive Example 2-5 using copper oxide having a specific surface area of $1.26 \text{ m}^2/\text{g}$ generates 0.1% CO whereas Comparative Example 2-2-4 using copper oxide having a specific

surface area of 0.31 m²/g generates 2.0% CO. Clearly this difference in the amount of noxious CO is unexpected based upon the disclosure of Taylor et al.

Also, the gas generant composition of Inventive Example 2-3 has an unexpected decrease in the amount of CO produced when compared to the gas generant composition of Comparative Example 2-2-2. Inventive Example 2-3 using copper oxide having a specific surface area of 10.16 m²/g generates 1.3% CO whereas Comparative Example 2-2-2 using copper oxide having a specific surface area of 0.31 m²/g generates 3.1% CO. Clearly this difference in the amount of noxious CO is unexpected based upon the disclosure of Taylor et al.

The Examiner will note that Inventive Example 2-3 and Comparative Example 2-2-2 each use azodicarbonamide as the nitrogen containing organic compound (note that this is a nitrogen containing organic compound having an amido group). Based upon this observation, Applicants respectfully submit that the skilled artisan would come to the reasonable conclusion that the unexpectedly superior properties of the present invention is controlled by the specific surface area of the copper oxide, not the type of nitrogen containing organic compound.

Third Component (3) -

As can be seen from the following table, the inventive composition containing a molybdenum compound of at least one

selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid, and ammonium molybdate has superior properties to compositions that do not contain these molybdenum species.

TABLE 2

Example	Mo Species	Carbon Monoxide Generated (%)	NO _x (ppm)
3-1 (Inventive)	molybdenum trioxide	0.6	200
3-2 (Inventive)	molybdic acid	0.4	180
3-3 (Inventive)	ammonium molybdate	0.5	100
3-3-1 (Comparative)	Absent	2.3	2000

As can be seen from the above-data taken from the present specification, the inventive composition containing a molybdenum compound of at least one selected from the group consisting of molybdenum trioxide, molybdic acid, and ammonium molybdate manganese dioxide has superior properties to compositions that do not contain these molybdenum species.

In general, a superior composition will generate a lower amount of carbon monoxide and nitrogen oxides. These results show that the carbon monoxide and nitrogen oxides generated from the composition is far less when using the inventive molybdenum species.

Also, Applicants respectfully submit that skilled artisan

would reasonably conclude from this data that molybdenum dioxide would have superior properties in a similar manner as the specific molybdenum species tested.

Since Taylor et al fail to teach or suggest the superior properties obtained when using the inventive composition containing molybdenum compound of at least one selected from the group consisting of molybdenum dioxide, molybdenum trioxide, molybdic acid, and ammonium molybdate, Taylor et al do not make obvious this aspect of the present claims.

Third Component (4) -

As can be seen from the following table, the inventive composition containing a mixture of manganese dioxide and at least one metal oxide selected from the group consisting of copper oxides, cobalt oxides, iron oxides and silver oxides has superior properties to compositions that do not contain this mixture.

TABLE 3

Example	Catalyst Species (parts)	NO _x (ppm)
4-1 (Inventive)	MnO ₂ (10) + CuO (10)	600
4-2 (Inventive)	MnO ₂ (10) + Co ₃ O ₄ (10)	500
4-3 (Inventive)	MnO ₂ (10) + Fe ₂ O ₃ (10)	700
4-4 (Inventive)	MnO ₂ (10) + Ag ₂ O (10)	650
4-5 (Inventive)	MnO ₂ (10) + Cu ₂ O (10)	600
4-6 (Inventive)	MnO ₂ (10) + CuO (10) + AgO (5)	440
4-7 (Inventive)	MnO ₂ (10) + Co ₃ O ₄ (10) + AgO (5)	370
4-8 (Inventive)	MnO ₂ (25) + CuO (2)	630
4-9 (Inventive)	MnO ₂ (20) + CuO (0.5)	1240
4-4-1 (Comparative)	absent	2000

As can be seen from the above-data taken from the present specification, the inventive composition containing a mixture of manganese dioxide and at least one metal oxide selected from the group consisting of copper oxides, cobalt oxides, iron oxides and silver oxides has superior properties to compositions that do not contain this mixture.

In general, a superior composition will generate a lower amount of nitrogen oxides. These results show that the nitrogen oxides generated from the composition is far less when using the inventive manganese mixture catalyst.

Since Taylor et al fail to teach or suggest the superior

properties obtained when using the inventive composition containing a mixture of manganese dioxide and at least one metal oxide selected from the group consisting of copper oxides, cobalt oxides, iron oxides and silver oxides, Taylor et al do not make obvious this aspect of the present claims.

Third Component Is Mixtures of (1)-(4) -

As can be seen from the following table, the inventive composition containing mixtures of the inventive third component has superior properties to compositions that do not contain these mixtures.

TABLE 4

Third Components	Ex.	Catalyst	Specific Surface Area (m ² /g)	Carbon Monoxide Generated (%)	NO _x (ppm)
(1) and (2)	5-1 (Inv)	MnO ₂ and CuO	MnO ₂ - 260 CuO - 4.99	0.4	1000
(1) and (3)	5-2 (Inv)	MnO ₂ and MoO ₃	MnO ₂ - 260	0.6	280
(1) and (3)	5-5 (Inv)	Molybdic acid and MnO ₂	MnO ₂ - 260	0.4	240
(1) and (4)	5-3 (Inv)	MnO ₂ and Iron oxide	MnO ₂ - 260	0.8	580
(2) and (3)	5-4 (Inv)	Molybdic acid and CuO	CuO - 4.99	0.4	250

As can be seen from the above-data taken from the present specification, the inventive composition containing mixtures of

the inventive third component has superior properties to compositions that do not contain manganese dioxide within this range.

Since Taylor et al fail to teach or suggest the superior properties obtained when using mixtures of the inventive third component, Taylor et al do not make obvious this aspect of the present claims.

In view of the foregoing, there are significant patentable distinctions between Taylor et al and the presently claimed invention.

Hinshaw et al. US 5,725,699 or JP 6-32690

Applicants respectfully submit that there are significant patentable distinctions between Hinshaw et al. US 5,725,699 or JP 6-32690 (hereinafter JP '690) and the presently claimed invention.

Applicants direct the Examiner's attention to EP 607446 (hereinafter EP '446) since EP '446 is in the same patent family as JP '690 and is in English.

Third Component (2) -

Part I -

The following comments relate to the inventive composition wherein the third component is (2) copper oxide having a specific surface area of not less than 1 m²/g. First, the patentable

distinctions will be discussed in relation to 35 USC 102 followed by 35 USC 103.

Applicants respectfully submit that neither JP '690 nor Hinshaw et al anticipate the presently claimed invention, since JP '690 and Hinshaw et al fail to teach that the copper oxide has a specific surface area of not less than 1 m²/g.

Both JP '690 and Hinshaw et al are silent with respect to the surface area of the copper oxide. In describing the requirements for anticipation, the Manual of Patent Examining Procedure (Section 2131) states:

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference (ref. omitted). The identical invention must be shown in as complete detail as is contained in the... claim (ref. omitted).

Accordingly, JP '690 and Hinshaw et al do not anticipate the claims, since JP '690 and Hinshaw et al fail to teach the inventive range of surface area of the copper oxide.

Furthermore, Applicants respectfully submit that an assertion that the compositions of JP '690 and Hinshaw et al inherently have the inventive range of the surface area of the copper oxide is not tenable. Applicants respectfully submit that the courts have not taken a similar position in similar cases. In *In re Pearson*, 181 USPQ 641 (CCPA 1974), the inherency issue involved a limitation of a composition used in a claimed process. The process inhibited the formation of small and malformed peanuts during the growth of peanut crops by applying a particular composition to the

foliage of the crops. The composition contained a calcium-containing compound having a "sufficiently small particle size to substantially reduce the formation of pops and unsound kernels." The cited prior art taught a process that involved spreading an inorganic salt on the ground surrounding the peanut plant. The court reversed the rejection of the claims reciting the use of particles less than 1 micron in size, finding no evidence that the composition used in the prior art process contained such small particles. *Id.* at 645.

To support an anticipation rejection based upon inherency, an Examiner must provide factual and technical grounds establishing that the inherent feature necessarily flows from the teachings of the prior art. See *Ex parte Levy* 17 USPQ2d 1461 (BOPAI 1990); see also *In re Oelrich*, 212 USPQ 323 (CCPA 1981) holding that inherency must flow as a necessary conclusion from the prior art, not simply a possible one.

Since there is no evidence that the composition of JP '690 and Hinshaw et al have copper oxide having a specific surface area of not less than 1 m²/g, Applicants respectfully submit that there are significant patentable distinctions between the present invention and the teachings of JP '690 and Hinshaw et al.

The following comments are respectfully submitted to show that the present invention is not made obvious by JP '690 or Hinshaw et al under 35 USC 103(a).

Since the cited references are silent with respect to the surface area of the copper oxide, the skilled artisan would reasonably conclude that the surface area of the copper oxide does not effect the properties of the copper oxide which are relevant to the gas generating ability of the composition.

Applicants have unexpectedly found that the surface area of the copper oxide does effect the properties of the copper oxide which are relevant to the ability of the composition to generate a safer gas mixture upon ignition. In fact, the inventive gas generant composition containing copper oxide having a specific surface area of not less than $1 \text{ m}^2/\text{g}$ has an unexpectedly superior ability to generate a safer gas mixture upon ignition then gas generant compositions containing copper oxide having a specific surface area of less than $1 \text{ m}^2/\text{g}$.

The gas generant composition of Inventive Example 2-5 has an unexpected decrease in the amount of CO produced when compared to the gas generant composition of Comparative Example 2-2-4. These compositions differ only with respect to the specific surface area of the copper oxide. The compositions were tested for the amount of carbon monoxide produced in the gas generating reaction. A superior composition will generate a lower amount of carbon monoxide. Inventive Example 2-5 using copper oxide having a specific surface area of $1.26 \text{ m}^2/\text{g}$ generates 0.1% CO whereas Comparative Example 2-2-4 using copper oxide having a specific surface area of $0.31 \text{ m}^2/\text{g}$ generates 2.0% CO. Clearly this

difference in the amount of noxious CO is unexpected based upon the disclosures of Hinshaw et al. and JP '690.

The gas generant composition of Inventive Example 2-3 has an unexpected decrease in the amount of CO produced when compared to the gas generant composition of Comparative Example 2-2-2. These compositions differ only with respect to the specific surface area of the copper oxide. The compositions were tested for the amount of carbon monoxide produced in the gas generating reaction. A superior composition will generate a lower amount of carbon monoxide. Inventive Example 2-3 using copper oxide having a specific surface area of 10.16 m²/g generates 1.3% CO whereas Comparative Example 2-2-2 using copper oxide having a specific surface area of 0.31 m²/g generates 3.1% CO. Clearly this difference in the amount of noxious CO is unexpected based upon the disclosures of Hinshaw et al and JP '690.

Third Component (1), (3), (4) and Mixtures of (1)-(4) -

Applicants respectfully submit that the above comments regarding the unexpectedly superior properties of the present composition over the composition of Taylor et al is equally applicable to the compositions of JP '690 and Hinshaw et al. As such, Applicants' above-comments are incorporated herein by reference.

In view of the foregoing, Applicants respectfully submit that there are significant patentable distinctions between the

presently claimed invention and the disclosures of JP '690 and Hinshaw et al.

Conclusion

Early and favorable action on the merits is earnestly solicited.

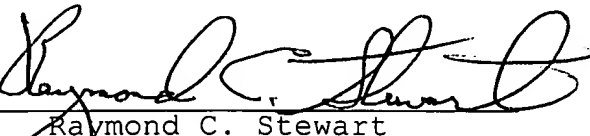
If the Examiner has any questions concerning this application, he is requested to contact Garth M. Dahlen, Ph.D. (#43,575) at (703) 205-8000 in the Washington, D.C. area.

A marked up version of the specification showing changes made is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachment: Marked up version of the specification showing changes made

**MARKED UP VERSION OF THE SPECIFICATION SHOWING CHANGES MADE
IN THE SPECIFICATION:**

The specification has been changed as follows:

The paragraph beginning on page 2, line 5 through page 3, line 2, has been amended as follows:

For the purpose of overcoming these problems, non-azide type gas generants have been under development in place of sodium azide type. For example, JP-A 3-208878 discloses a composition which comprises a main component of oxygen-containing oxidizer such as tetrazole, triazole, or their metal salts combined with ammonium perchlorate or sodium nitrate and an auxiliary component of a metal oxide such as V_2O_5 , CuO or Fe_2O_3 . The metal oxide mentioned forms a solid combustion product, which is easily removed by filtration when undesired components are removed by filtration prior to release the formed gas into the bag in an air bag system, and converts CO which is toxic to human bodies generated from the nitrogen-containing organic compound to CO_2 . JP-B 64-6156 and JP-B 64-6157 disclose a gas generant which contains, as the main component, a metal salt of bitetrazole compound that does not contain hydrogen. [JP-A 3-208878] JP-A-5-213687 further discloses a gas generant having a transition metal complex of aminoarazole as the main component. These non-azide type compounds disclosed in the series of prior art references are characteristic in that the concentration of carbon monoxide released is low since the

carbon number in the one molecule is small; however, the amount of nitrogen oxides, toxic to human bodies, increases in all the cases and the performance is not satisfactory in respect of the inflation period of the bag.

The paragraph beginning on page 30, line 25 through page 31, line 3, has been amended as follows:

[Example 1] Example 4-1 was repeated except that manganese dioxide and copper oxide were not added to evaluate the concentration of nitrogen oxides in the gas generated in the tank.

The burning pressure and period were of desired values. The concentration of nitrogen oxides in the gas generated in the tank was not less than 2,000 ppm.

The paragraph on page 32, lines 6-12, has been amended as follows:

--[Example 1] Example 4-1 was repeated except that the amount of catalyst addition was changed to 25 parts of manganese dioxide and 2 parts of copper (II) oxide to evaluate the concentration of nitrogen oxides in the gas generated in the tank. The burning pressure and period were of desired values. The concentration of nitrogen oxides in the gas generated in the tank was 630 ppm.--

New claims 25-31 have been added.